

REMARKS

Claims 1 to 45 are currently pending in this application. Claims 1 to 45 have been rejected. Applicants have amended claims 1, 2, 16, 20, 29 and 40. No new matter has been added; full support for the amendments being found in the specification and drawings as filed. In view of the above amendments and the following remarks, Applicants submit that this application is in condition for allowance. Accordingly, reconsideration and a timely indication of allowance are respectfully requested.

Claim Amendments

Applicants have amended claim 1 to recite “receiving sensor data for the application environment, said sensor data being related to energy consumption of a cycle of the application environment” and “generating an energy transfer profile modeling the battery state of charge over time in future cycles of the application environment based upon the received sensor data and the received charge parameters.” Applicants have amended claim 2 to change the term “determining” to “generating” in view of the amendments to claim 1. Applicants have amended claim 16 to recite “receiving recorded sensor data for the vehicle relating to energy consumption over time for a cycle of the application environment” and “generating the energy transfer profile for the vehicle modeling the battery state of charge over time in future cycles of the application environment based upon said recorded sensor data and said parameters.”

Applicants have amended claim 20 to recite “memory for storing sensor data corresponding to energy consumption during a cycle of the application” and “a component responsive to said sensor data and said application parameters for generating the energy transfer profile modeling the battery state of charge over time in future cycles of the application.” Applicants have amended claim 29 to recite “means for receiving sensor data for the application environment, said sensor data being related to energy consumption of a cycle of the application environment” and “means for determining an energy transfer profile modeling the battery state of charge over time in future cycles of the application environment based upon said sensor data and

said charge parameters.” Applicants have amended claim 40 to recite “computer executable instructions for receiving recorded sensor data for the application environment regarding energy consumption over time of a cycle of the application environment” and “computer executable instructions for generating the an energy transfer profile modeling the battery state of charge over time in future cycles of the application environment based upon said sensor data and said application environment parameters.” Additionally, claims 1, 16, 20, 29 and 40 have been amended for clarity. All of amendments find full support in the specification and drawings as filed, for example in paragraphs 5, 31 to 36, 42 and 45 to 52 of the specification and in Figs. 5, and 7 to 10. No new matter has been added.

Entry of these amendments is respectfully requested.

The Present Invention

The present application is directed to a system and method for modeling or simulating the effect of charging and discharging on a selected battery when it is used in a particular application environment and recharged in accordance with a selected charge return model. The energy needs of the application environment are defined by gathering real-world sensor data from a battery in use in the application environment over an actual cycle of use. This data is then used to determine the energy needs of the application environment and, thus, the energy discharge demands upon a battery over time during future cycles of use in the application environment.

To perform modeling or simulating, a particular battery may be selected; the characteristics of the selected battery may be defined by its charge parameters. A charge return model is also selected to define the type and characteristics of the recharging operation. All of these factors are evaluated over a predefined charge schedule, wherein the charge schedule defines the times during which the battery is available for recharging. In an embodiment, the present invention attempts to simulate or model the effect of charging and discharging on a selected battery in an industrial vehicle employed during scheduled shift work. The battery is available for recharging during specified times, such as lunch breaks, shift changes, or overnight.

The result of the modelling or simulation operation is production of an energy transfer profile. The energy transfer profile models the impact on the selected battery of the discharging and charging predicted to occur over the course of the charging schedule in the application environment. As seen from Figs. 7 to 10, the energy transfer profile allows a user to evaluate whether a particular battery and/or a particular charge return model is appropriate for a given application environment.

Rejections Under 35 U.S.C. § 103(a)

The Patent Office rejected claims 1-5, 12-15, 29-33 and 36-39 under 35 U.S.C. § 103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812). The rejection has been carefully considered but is traversed for the reasons that follow.

Claim 1, as amended, requires “generating an energy transfer profile modeling the battery state of charge over time in future cycles of the application environment based upon the received sensor data and the received charge parameters.” Claim 29, as amended, requires “means for determining an energy transfer profile modeling the battery state of charge over time in future cycles of the application environment based upon said sensor data and said charge parameters.” Applicants respectfully submit that neither Joko et al. nor Hotta teach or suggest these limitations.

Joko et al., are concerned with observing the state of a battery in a hybrid gasoline-electric automobile. More specifically, Joko et al. teach a means for calculating the time integral I of the charging and discharging current (i)(Column 12, lines 53 to 58). According to Joko et al., this information is used to compare the measured transfer characteristic of a specific battery in use to a set of stored characteristics to evaluate the condition of the battery and prevent battery damage through overcharging (Column 18, lines 52 to 58). The hybrid vehicles focused on by Joko et al., do not have set discharge and charge schedules, because the vehicles can travel different routes with highly variable opportunities for regenerative braking. Indeed, the hybrid

vehicles taught in Joko et al. do not plug into a charger, and therefore have no specified charging time. Therefore, Joko et al. do not attempt to model battery state of charge over time in future cycles of the application environment as claimed, but rather focus on the current state of the battery. While a hybrid vehicle as taught in Joko et al. could be used in a cyclical environment, such use is not contemplated, and no energy transfer profile as claimed herein is taught or suggested.

Hotta is directed to an apparatus for controlling “the charging of a storage battery of an electric vehicle to optimize charging while accommodating any electrical loads that may be imposed on the storage battery, such as an air conditioning unit or an accessory.” (See Abstract). Hotta considers whether a battery can be fully charged during an interval prior to a scheduled boarding time. However, Hotta fails to teach or suggest consideration of the energy consumption of the application environment for which the battery will be used. Hotta fails to teach modeling the battery state of charge over time in future cycles of the application environment to determine whether the battery will be able to meet the needs of the application environment. Accordingly, Applicants respectfully submit that Hotta fails to remedy the defects of Joko et al.

Additionally, independent claims 1 and 29, as amended, require determining an energy transfer profile based upon charge parameters, the charge parameters including a charge schedule, “said charge schedule defining times and time intervals during which the battery is available for charging.” The Examiner admits that Joko et al. fail to teach or suggest this limitation. However, the Examiner cites to Hotta to remedy this defect of Joko et al.

Applicants respectfully submit that one skilled in the art would have no motivation to combine the teachings of Joko et al. with Hotta. The Examiner states that it would have been obvious to a person having ordinary skill in the art at the time of this invention “to add a charge schedule control system in Joko’s battery control system in order to prevent the energy storage battery from being unduly consumed.” Applicants respectfully disagree and submit that one skilled in the art would have no motivation to combine the electric vehicle apparatus of Hotta with the hybrid vehicle system of Joko et al. A hybrid vehicle has the ability to use the gasoline

engine to charge the batteries as needed, which alleviates the concern in Hotta that reduction in the amount of battery charge would limit vehicle range.

Joko et al. relates to dynamically controlling the charging and discharging of a battery based on an ongoing monitoring of the state of charge of the battery. Nothing in Joko et al. suggest a reflective analysis or modeling of the charging and discharging that may occur given a selected set of charge parameters, energy needs, and a charge return model over the course of a charge schedule. In the context of Joko et al., one cannot define particular times in a schedule during which the battery is available for charging. The nature of regenerative braking is such that it cannot be scheduled. Therefore, modification of Joko et al. to consider a charge schedule, as claimed, would change the principal of operation of Joko et al.

Accordingly, Applicant respectfully submits that claims 1 and 29, as amended, are patentable over Joko et al. and Hotta, either alone or in combination, because Joko et al. and Hotta do not teach or suggest each and every feature recited in any of claims 1 and 29, and because one skilled in the art would have no motivation to combine Joko et al. with Hotta. Claims 2 to 5, 12 to 15, 30 to 33 and 36 to 39 depend from claims 1 and 29 and by definition contain all of the limitations of the independent claim upon which they depend. Accordingly, Applicant respectfully submits that claims 2 to 5, 12 to 15, 30 to 33 and 36 to 39 are patentable over Joko et al. and Hotta for the reasons given above for claims 1 and 29, as well as because of the additional limitations contained therein.

Rejections Under 35 U.S.C. §103(a)

The Examiner rejected claims 16 to 23 and 40 to 44 under 35 U.S.C. §103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Pavlovic et al. (U.S. Patent No. 6,965,216). The Examiner's rejection has been carefully considered but is traversed for the reasons that follow.

Applicants respectfully submit that the references cited by the Examiner do not disclose, teach or suggest "generating the energy transfer profile for the vehicle modeling the battery state

of charge over time in future cycles of the application environment based upon said recorded sensor data and said parameters” as recited in claim 16. Additionally, the references cited by the Examiner do not disclose, teach or suggest an “energy transfer module including a component responsive to said sensor data and said application parameters for generating the energy transfer profile modeling the battery state of charge over time in future cycles of the application” as recited in claim 20. Additionally, the references cited by the Examiner do not disclose, teach or suggest “computer executable instructions for generating ~~the~~ an energy transfer profile modeling the battery state of charge over time in future cycles of the application environment based upon said sensor data and said application environment parameters” as recited in claim 40.

As explained above with regard to claims 1 and 29, Applicants respectfully submit that Joko et al. and Hotta, taken alone or in combination fail to teach or suggest determining an energy transfer profile modeling the battery state of charge over time in future cycles of the application environment based upon received sensor data and charge parameters as claimed. Moreover, as explained above, Applicants respectfully submit that one skilled in the art would have no motivation to combine Joko et al. with Hotta.

Pavlovic et al. is directed to an apparatus and method for recharging a rechargeable lead acid battery. The apparatus supplies an overcharge current to the battery and before completion of recharging of the battery to ameliorate stratification of the battery. Applicants respectfully submit that Pavlovic et al. fail to remedy the defects of Joko et al. and Hotta.

Accordingly, Applicants respectfully submit that claims 16, 20, and 40 are patentable over Joko et al., Hotta, and Pavlovic et al., alone and in combination. Claims 17 to 19, 21 to 23 and 41 to 44 depend from claims 16, 20, and 40 and by definition contain all of the limitations of claims 16, 20, 40. Applicants respectfully submit that claims 17 to 19, 21 to 23 and 41 to 44 are patentable over Joko et al., Hotta, and Pavlovic et al for the reasons given above for claims 16, 20, and 40 as well a because of the additional limitations contained therein.

Therefore, Applicants respectfully request that the rejection of claims 16 to 23 and 40 to 44 under 35 U.S.C. §103(a) be withdrawn.

Additional Rejections of Dependent Claims Under 35 U.S.C. § 103(a)

The Examiner rejected claims 6 to 9 and 34 under 35 U.S.C. § 103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Notten et al. (U.S. Patent No. 6,016,047). The Examiner rejected claim 10 under 35 U.S.C. 103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Notten et al. (U.S. Patent No. 6,016,047) and further in view of L. Martin (Journal of Heat Transfer, Nov. 1991, Vol. 113/899). The Examiner rejected claim 11 under 35 U.S.C. §103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Hughes et al. (U.S. Patent No. 6,326,765). The Examiner rejected claim 11 under 35 U.S.C. §103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Aker et al. (U.S. Patent No. 6,803,746).

The Examiner rejected claims 24 to 27 under 35 U.S.C. §103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Pavlovic et al. (U.S. Patent No. 6,965,216) and further in view of Hughes et al. (U.S. Patent No. 6,326,765). The Examiner also rejected claims 24 to 28 under 35 U.S.C. §103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Pavlovic (U.S. Patent No. 6,965,216) and further in view of Aker et al. (U.S. Patent No. 6,803,746).

The Examiner rejected claim 28 under 35 U.S.C. § 103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Pavlovic et al. (U.S. Patent No. 6,965,216) in view of Hughes et al. in further view of Koenck (U.S. Patent No. 5,463,305) and as being unpatentable over Joko et al., Hotta, and Aker et al. in further view of Koenck. The Examiner rejected claim 35 under 35 U.S.C. §103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Notten et al. and further in view of Hughes et al. The Examiner also

rejected claim 35 under 35 U.S.C. §103(a) as being obvious over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Notten et al., and further in view of Aker et al. Finally, the Examiner rejected claim 45 under 35 U.S.C. § 103(a) as being unpatentable over Joko et al. (U.S. Patent No. 5,939,861) in view of Hotta (U.S. Patent No. 5,686,812) in view of Pavlovic et al. (U.S. Patent No. 6,965,216) in further view of Koenck.

The Examiner's rejections have been carefully considered but are traversed for the reasons that follow.

Claims 6 to 11, 24 to 28, 35 and 45 depend from claims 1, 20, 29 and 40 and by definition contain all of the limitations of claims 1, 20, 29 and 40. As explained above, Applicants respectfully submit that Joko et al. and Hotta fail to teach to teach or suggest all of the limitations of any of claims 1, 20, 29 and 40, because Joko et al. and Hotta, taken alone or in combination fail to teach suggest generating an energy transfer profile modeling the battery state of charge over time in future cycles of the application environment based upon sensor data and charge parameters as claimed.

As also explained above, Applicants respectfully submit that one skilled in the art would have no motivation to combine Joko et al. with Hotta. Applicants respectfully submit that Pavlovic et al., Notten et al., L. Martin, Hughes, Aker et al., and Koenck, taken alone or in combination, fail to remedy the defects of Joko et al. and Hotta.

Additionally, Applicants respectfully submit that one skilled in the art would have no motivation to combine Joko et al. with Hughes et al. Hughes et al. is directed to an electric scooter with an on-board charging system. The Examiner states that it would have been obvious to a person having ordinary skill in the art at the time of this invention to use Hughes et al.'s charging method, which according to the Examiner includes using an IVI profile with Joko et al.'s device to provide a full charge to the battery in less time than typical charging methods. Applicant respectfully disagrees.

As explained in Fig. 3 and in the specification in col. 2, line 1 to col. 3, line 17, Hughes et al.'s charging method referred to by the Examiner is used with a steady power source, namely a

fuel cell for charging a battery pack. Applicant submits that the charging method of Hughes et al. cannot be combined with the hybrid vehicle system of Joko et al, because regenerative braking, which is the charge mechanism of Joko et al. is unscheduled and highly variable in duration. Thus, there is a lack of suggestion to combine the references.

Additionally, Applicants respectfully submit that one skilled in the art would have no motivation to combine the battery control system of Joko et al. with the high capacity charger taught by Aker et al. Applicants respectfully submit that one skilled in the art would not be motivated to combine the regenerative braking system of Joko et al., which is unscheduled and highly variable in duration, with the high capacity charger taught by Aker et al. Thus, there is a lack of suggestion to combine the references.

Finally, Applicants respectfully submit that the need to rely on combinations of four and five references as a basis for obviousness amounts to a hindsight analysis which in itself supports a finding that the invention is not obvious.

Accordingly, Applicants respectfully submit that claims 1, 20, 29 and 40 are patentable over the references cited by the Examiner. Additionally, Applicants respectfully submit that claims 6 to 11, 24 to 28, 35 and 45 are patentable over the references cited by the Examiner for the reasons given above for claims 1, 20, 29 and 40 as well as because of the additional limitations contained therein. Accordingly, Applicants respectfully request that the rejections of claims 6 to 11, 24 to 28, 35 and 45 be withdrawn.

CONCLUSION

In view of the above amendments remarks, Applicants respectfully submit that this application is in condition for allowance. Accordingly, reconsideration and a timely indication of allowance are respectfully requested.

If the Examiner believes a telephone conference would aid in the prosecution of this application, then the Examiner is invited to contact the undersigned at the below-listed telephone number.

A fee of \$1020 is believed due with this communication for a three month extension of time. Additionally, a fee of \$790 is believed due with the Request For Continued Examination filed herewith. The Commissioner is hereby authorized to charge these fees and any other fees due with this communication to Deposit Account No. 19-2090.

Respectfully submitted,
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